

Claims

What is claimed is:

1. A valve actuation system, comprising:  
an engine valve moveable between a first position at which engine valve prevents a flow of fluid relative to the engine valve and a second position at which the fluid flows relative to the engine valve;  
a cam follower operatively connected to the engine valve;  
a first cam adapted to engage the cam follower to move the engine valve from the first position to the second position during a first lift period;  
a second cam adapted to engage the cam follower to affect movement of the engine valve between the first position and the second position during a second lift period; and  
a phase shifting device operatively connected to the second cam to adjusting the relative timing between the first lift period and the second lift period.
2. The system of claim 1, wherein the phase shifting device includes a helical spline and a hydraulic actuator.
3. The system of claim 1, wherein the second lift period overlaps with at least a portion of the first lift period.
4. The system of claim 1, wherein the cam follower includes a first end and a second end, the first end and the second end being pivotable about a central axis.

5. The system of claim 4, wherein the first cam selectively engages the first end of the cam follower and the second cam selectively engages the second end of the cam follower.

6. The system of claim 1, further including a rocker arm operatively connected to the engine valve and a push rod operatively connected between the cam follower and the rocker arm.

7. The system of claim 1, further including a first impact absorbing device, adapted to absorb the impact between the first cam and the first end of the cam follower.

8. The system of claim 1, further including a second impact absorbing device, adapted to absorb the impact between the second cam and the second end of the cam follower.

9. A method of actuating an engine valve having a first position at which the engine valve prevents a flow of fluid relative to the engine valve and a second position at which fluid flows relative to the engine valve, comprising:

rotating a first cam to move the engine valve between the first position and the second position during a first lift period;

rotating a second cam to engage the cam follower to thereby affect movement of the engine valve between the first position and the second position during a second lift period; and

adjusting a rotational phase of the second cam to thereby adjust the relative timing between the first lift period and the second lift period.

10. The method of claim 9, wherein the second lift period overlaps with at least a portion of the first lift period.

11. The method of claim 9, further including absorbing an impact between the first cam and a first end of a cam follower operatively associated with the engine valve.

12. The method of claim 9, further including absorbing an impact between the second cam and a second end of a cam follower operatively associated with the engine valve.

13. A valve actuation system, comprising:  
an engine valve moveable between a first position at which the engine valve prevents a flow of fluid relative to the engine valve and a second position at which the fluid flows relative to the engine valve;  
a cam follower operatively connected to the engine valve;  
a first cam adapted to engage the cam follower to move the engine valve from the first position to the second position during a first lift period;  
a second cam adapted to engage the cam follower to affect movement of the engine valve between the first position and the second position during a second lift period; and  
a means for shifting a phase of the second cam to thereby adjust the relative timing between the first lift period and the second lift period.

14. The system of claim 13, further including a means for absorbing an impact between the first cam and the first end of the cam follower.

15. The system of claim 14, further including a second means for absorbing an impact between the second cam and the second end of the cam follower.

16. An engine, comprising:

a block defining a combustion chamber;

a crankshaft;

an engine valve operatively associated with the combustion chamber and moveable between a first position at which the engine valve prevents a flow of fluid relative to the combustion chamber and a second position at which the fluid flows relative to the combustion chamber;

a cam follower operatively connected to the engine valve;

a first cam adapted to engage the cam follower such that the rotation of the first cam, in response to a rotation of the crankshaft, acts to move the engine valve from the first position to the second position during a first lift period;

a second cam adapted to engage the cam follower such that the rotation of the second cam, in response to a rotation of the crankshaft, acts to affect the movement of the engine valve from the first position to the second position during a second lift period; and

a phase shifting device operatively connected to the second cam and adapted to adjusting the relative timing between the first lift period and the second lift period.

17. The engine of claim 16, wherein the phase shifting device includes a helical spline and a hydraulic actuator.

18. The engine of claim 16, wherein the second lift period overlaps with at least a portion of the first lift period.

19. The engine of claim 16, wherein the cam follower includes a first end, and a second end, the first end and the second end being pivotable about a central point.

20. The engine of claim 19, wherein the first cam selectively engages the first end of the cam follower and the second cam selectively engages the second end of the cam follower.

21. The engine of claim 16, further including a rocker arm operatively connected with the engine valve and a push rod operatively connected between the cam follower and the rocker arm.

22. The engine of claim 16, further including:  
a first impact absorbing device adapted to absorb the impact between the first cam and the first end of the cam follower; and  
a second impact absorbing device adapted to absorb the impact between the second cam and the second end of the cam follower.